TWO GENERATIONS OF HEXAGONAL $CaAl_2Si_2O_8$ (DMISTEINBERGITE) IN THE TYPE B2 FUN CAI STP-1.

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Introduction: Dmisteinbergite (*dmist*) is a metastable hexagonal form of $CaAl_2Si_2O_8$, with space group of $P6_3/mcm$, a = 5.10Å and c = 14.72Å [1]. First occurrence of meteoritic *dmist* has been reported in the Allende Type B2 FUN CAI *STP-1* [2], where it appears to have crystallized from a ^{16}O-rich ($\Delta^{17}O \sim -25‰$) silicate melt via rapid cooling [3]. Here we report on another textural occurrence of *dmist* in *STP-1* – ^{16}O-poor ($\Delta^{17}O \sim -2‰$) fine-grained crystals in alteration zone of the inclusion.

The mineralogy and mineral chemistry of *STP-1* were studied with the UH field-emission JEOL JXA-8500F electron microprobe and JEOL JSM-5900LV equipped with electron backscattered diffraction detector HKLNordlys. Oxygen isotopes were measured *in situ* with the UH Cameca ims-1280 ion microprobe using primary Cs^+ ion beam with ~2 μm beam size.

Results and Discussion: *STP-1* is a Type B2 CAI composed of melilite, Al,Ti-diopside, spinel, *dmist*, and minor hibonite. Melilite in the CAI periphery is partly replaced by secondary nepheline, sodalite, grossular, Al-diopside, hexagonal *dmist*, and triclinic anorthite. Secondary *dmist* occurs as acicular crystals whereas secondary anorthite forms anhedral massive grains. Secondary *dmist* and anorthite contain up to 1 wt% of Na_2O, whereas primary *dmist* is Na-free. On a three-oxygen isotope diagram, secondary *dmist* and anorthite plot along slope-1 line have ^{16}O-poor compositions ($\Delta^{17}O \sim -2‰$); one *dmist* grain is ^{16}O-enriched ($\Delta^{17}O \sim -10‰$). In contrast, O-isotope compositions of coarse-grained igneous *dmist* plot along ~slope-0.5 line with $\Delta^{17}O \sim -25‰$. Experimental studies show that in supercooled melts *dmist* crystallizes prior to anorthite at temperatures below metastable liquidus (1400°C) [e.g., 4]. These observations and the fractionated O-isotope compositions of coarse-grained igneous *dmist* in *STP-1* suggest that it crystallized from a supercooled melt that experienced evaporation, possibly at low total pressure ($<10^{-6}$ bar) [5]. On the contrary, fine-grained *dmist* coexisting with secondary minerals is likely to have formed by hydrothermal alteration on the CV parent asteroid, which is consistent with its ^{16}O-depleted composition and elevated Na_2O content. Experimental studies suggest during hydrothermal alteration at 200–250°C, reaction of gehlenitic melilite with SiO_2 dissolved in an aqueous solution/fluid may result in formation of hydrogrossular [6]. Subsequent heating may transform hydrogrossular into *dmist* that is stable up to 1000°C [7]. We infer that *STP-1* contains two generations of *dmist* – igneous and hydrothermal. Crystallization of igneous *dmist* from a Type B2 FUN CAI melt indicates that the melt experienced supercooling at the final stages of crystallization. Subsequently, *STP-1*, like many typical CV CAIs, experienced hydrothermal alteration on the CV parent asteroid.

References: [1] Takeuchi & Donnay (1959) *Acta Crystallogr.* 12, 465–470. [2] Ma et al. (2013) *Amer. Mineral.*:in press. [3] Holst et al. (2013) *PNAS*:in press. [4] Abe & Sunagawa (1995) *Mineral. J.* 17:257–281. [5] Mendybaev et al. (2013) *GCA*:in press. [6] Nomura & Miyamoto (1998) *GCA* 62:3575–3588. [7] Borglum et al. (1993) *J. Am. Ceram. Soc.* 76:1354–1356.